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THE DRI*WEFA U.S. MACROECONOMIC MODEL

DRI*WEFA Macroeconomic Model is a multiple-equation model of the U.S. economy. Consisting of over 1,200 equations, the model is solved iteratively to generate the results of different policy and forecast scenarios. The model incorporates the best insights of many theoretical schools of thought to depict the economic decision processes and interactions of households, businesses, and governments.

The DRI*WEFA model is divided into the following eight major sectors:

- I Private Domestic Spending
- II Production and Income
- III Taxes
- IV International Transactions
- V Financial
- VI Inflation
- VII Supply
- VIII Expectations
- I. Private Domestic Spending. Major aggregate demand components include consumption, investment, and government. Consumer purchases are divided among three categories: durable goods, nondurable goods, and services. In nearly all cases, real expenditures are influenced by real income and the relative price of consumer goods. Durable and semidurable goods are also sensitive to household net worth, current finance costs, and consumer sentiment.

DRI*WEFA divides investment into two general categories: fixed investment and inventories. The former is driven by utilization rates, capital stock, relative prices, financial market conditions, financial balance sheet conditions, and government policies. Inventory investment is heavily influenced by such factors as past and present sales levels, vendor performance, and utilization rates.

The government sector is divided into federal government and state and local government. Most of the federal expenditure side is exogenous. Federal receipts are endogenous and divided into personal taxes, corporate taxes, indirect business taxes, and contributions for social insurance. State and local sector receipts depend primarily on federal grants and various tax rates and bases. State and local government spending is driven by legal requirements (i.e., balanced budgets), the level of federal grants (due to the matching requirements of many programs), population growth, and trend increases in personal income.

II. **Production and Income**. The industrial production sector includes 74 standard industrial classifications. Production is a function of various cyclical and trend variables and a generated output term, i.e., the input-output (I-O) relationship between the producing industry and both intermediate industries and final demand. The cyclical and trend variables correct for changes in I-O coefficients that are implied by the changing relationship between buyers and sellers.

Pre-tax income categories include private and government wages, corporate profits, interest rate, and entrepreneurial returns. Each of these categories, except corporate profits, is determined by some combination of wages, prices, interest rates, debt levels, capacity utilization rate, and unemployment

- rate. Corporate profits are calculated as the residual of total national income less the non-profit components of income mentioned above.
- III. **Taxes.** The model tracks personal, corporate, payroll, and excise taxes separately. Tax revenues are simultaneously forecast as the product of the rate and the associated pre-tax income components. The model automatically adjusts the effective average personal tax rate for variations in inflation and income per household, and the effective average corporate rate for credits earned on equipment, utility structures, and R&D. State taxes are fully endogenous, except for corporate profits and social insurance tax rates.
- IV. **International.** The international sector can either add or divert strength from the central flow of domestic income and spending. Imports' ability to capture varying shares of domestic demand depends on the prices of foreign output, the U.S. exchange rate, and competing domestic prices. Exports' portion of domestic spending depends on similar variables and the level of world gross domestic product. The exchange rate itself responds to international differences in inflation, interest rates, trade deficits, and capital flows between the U.S. and its competitors. Investment income flows are also explicitly modeled.
- V. **Financial.** The DRI*WEFA model includes a highly detailed financial sector. Several short- and long-term interest rates are covered in this model, and they are the key output of this sector. The short-term rates depend upon the balance between the demand and supply of reserves in the banking system. The supply of reserves is the primary exogenous monetary policy lever within the model, reflecting the Federal Reserve's open market purchases or sales of Treasury securities. Longer-term interest rates are driven by shorter-term rates as well as factors affecting the slope of the yield curve. These factors include inflation expectations, government borrowing requirements, and corporate finance needs.
- VI. **Inflation**. Inflation is modeled as a controlled, interactive process involving wages, prices, and market conditions. The principal domestic cost influences are labor compensation, nonfarm productivity, and foreign input costs that later are driven by the exchange rate, the price of oil, and foreign wholesale price inflation. This set of cost influences drives each of the industry-specific producer price indexes, in combination with a demand pressure indicator and appropriately weighted composites of the other producer price indexes.
- VII. **Supply.** In this model, aggregate supply (or potential GNP), is estimated by a Cobb-Douglas production function that combines factor input growth and improvements to total factor productivity. Factor input equals a weighted average of labor, business fixed capital, and energy. Factor supplies are defined by estimates of the full employment labor force, the full employment capital stock net of pollution abatement equipment, the domestic production of petroleum and natural gas, and the stock of infrastructure. Total factor productivity depends upon the stock of research and development capital and trend technological change.
- VIII. **Expectations.** Expectations impact several expenditure categories in the model, but the principal nuance relates to the entire spectrum of interest rates. Shifts in price expectations or the expected government capital needs influences are captured directly in this model through price expectations and budget deficit terms. The former impacts all interest rates and the latter impacts intermediate- and long-term rates. On the expenditure side, inflationary expectations impact consumption via consumer sentiment, while growth expectations affect business investment.

THE IDAHO ECONOMIC MODEL

The Idaho Economic Model (IEM) is an income and employment based model of Idaho's economy. The Model consists of a simultaneous system of linear regression equations, which are estimated using quarterly data. The primary exogenous variables are obtained from the DRI*WEFA U.S. Macroeconomic Model. Endogenous variables are forecast at the statewide level of aggregation.

The focal point of the IEM is Idaho personal income, which is given by the identity:

personal income = wage and salary payments + other labor income + farm proprietors' income + nonfarm proprietors' income + property income + transfer payments - contributions for social insurance + residence adjustment.

With the exception of farm proprietors' income and wage and salary payments, each of the components of personal income is estimated stochastically by a single equation. Farm proprietors' income and wage and salary payments each comprise submodels containing a system of stochastic equations and identities.

The farm proprietor sector is estimated using a highly aggregated submodel consisting of equations for crop marketing receipts, livestock marketing receipts, production expenses, inventory changes, imputed rent income, corporate farm income, and government payments to farmers. Farm proprietors' income includes inventory changes and imputed rent, but this component is netted out of the tax base.

At the heart of the IEM is the wage and salary sector, which includes stochastic employment equations for 18 Standard Industrial Classification (SIC) employment categories. Conceptually, the employment equations are divided into basic and domestic activities. The basic employment equations are specified primarily as functions of national demand and supply variables. Domestic employment equations are specified primarily as functions of state-specific demand variables. Average annual wages are estimated for several broad employment categories and are combined with employment to arrive at aggregate wage and salary payments.

The demographic component of the model is used to forecast components of population change and housing starts. Resident population, births, and deaths are modeled stochastically. Net migration is calculated residually from the estimates for those variables. Housing starts are divided into single and multiple units. Each equation is functionally related to economic and population variables.

The output of the IEM (i.e., the forecast values of the endogenous variables) is determined by the parameters of the equations and the values of exogenous variables over the forecast period. The values of equation parameters are determined by the historic values of both the exogenous and endogenous variables. IEM equation parameters are estimated using the technique of ordinary least squares. Model equations are occasionally respecified in response to the dynamic nature of the Idaho and national economies. Parameter values for a particular equation (given the same specification) may change as a result of revisions in the historic data or a change in the time interval of the estimation. In general, parameter values should remain relatively constant over time, with changes reflecting changing structural relationships.

While the equation parameters are determined by structural relationships and remain relatively fixed, the forecast period exogenous variable values are more volatile determinants of the forecast values of endogenous variables. They are more often subject to change as expectations regarding future economic behavior change, and they are more likely to give rise to debate over appropriate values. As mentioned above, the forecast period values of exogenous variables are primarily obtained from DRI*WEFA's U.S. Macroeconomic Model.

Since the output of the IEM depends in large part upon the output of the DRI*WEFA model, an understanding of the DRI*WEFA model, its input assumptions, and its output is useful in evaluating the results of the IEM's forecast. The assumptions and output of the DRI*WEFA model are discussed in the National Forecast section.

IDAHO ECONOMIC MODEL

 $+ 8.96177*ID0NEWMFN\1/ID0NEWMF\1*JRWSSNF$

ID0AVGW\$ ID0AVGW\$= ((ID0WBB\$-ID0WBBF\$-ID0WBBMIL\$)/ID0NEW)*1000

ID0EXFP = -0.865627 + 3.44748*WPI01

ID0GIA\$ ID0GIA\$= 94.1811 + 926.890*VAIDGF@SL*ID0NPT/N

ID0HSPR ID0HSPRS1@A + ID0HSPRS2A@A

1,RMMTGENS)) + 107.354*(MOVAVG(4 TO 1,ID0NPT)-MOVAVG(8 TO

5,ID0NPT)) + 0.0433369*ID0KHU\1

ID0HSPRS2A@A ID0HSPRS2A@A= 9.07829 + 47.3557* (MOVAVG(4 TO 1,ID0NPT)-MOVAVG(8 TO

5.ID0NPT)) - 0.318939*MOVAVG(3 TO 0.RMMTGENS) - 0.0313305*TIME

+ 15.7*JQIND39*100/81.2

ID0IP26&27 ID0IP26&27=252.3*JQIND26*100/498.1 + 245.8*JQIND27*100/498.1

ID0KHU = ID0KHU1 + ID0KHU2A

ID0KHU2A $ID0KHU2A = ((1-0.003)**.25)*ID0KHU2A \ 1 + ID0HSPRS2A@A/4$

ID0ND ID0ND= -0.112418 + 5.90346*ID0NPT + 0.00965366*TIME

IDONEW IDONEW IDONEWMF + IDONEWNM

 $ID0NEWCC = -14.7580 + 0.0226624*ID0HSPRS1@A + 0.133843*ID0HSPRS1@A \setminus 1 + 0.133843*ID0HSPRS1AAA + 0.133843*ID0HSPRS1AAA + 0.1338$

 $0.245024*ID0HSPRS1@A\2+0.356205*ID0HSPRS1@A\3+$

 $0.467386*ID0HSPRS1@A\4 + 0.578567*ID0HSPRS1@A\5 + 0.152184*TIME$

+ 25.7965*ID0NPT - 4.46584*DUM861ON - 3.29976*DUM981ON

ID0NEWGOOD ID0NEWGG + ID0NEWMG + ID0NEWCC

ID0NEWGV ID0NEWGVF + ID0NEWGVSL

ID0NEWGVF ID0NEWGVF= -2.08899 + 1027.77*EGF*(ID0NPT/N) + 3.84519*

EGF*(GFO96C/GF96C) - 0.00488090*TIME

ID0NEWGVSL ID0NEWGVSLED + ID0NEWGVSL@ED

+ 0.591340*MOVAVG(8 TO 4,ID0YPTXB) + 0.143778*TIME

ID0NEWMF ID0NEWMFD + ID0NEWMFN

ID0NEWMFD ID0NEWMFD= ID0NEW24 + ID0NEW32&34 + ID0NEW35&36 + D0NEWMFDNEC

ID0NEWMFDNEC ID0NEWMFDNEC= -3.95549 + 0.0826892*ID0IPMFDNEC

ID0NEWMFN ID0NEWMFN= ID0NEW20 + ID0NEW26&27 + ID0NEW28 + ID0NEWMFNNEC

- 0.0879622*DUM87ON

ID0NEWMG ID0NEWMG@10 + ID0NEW10

+ 0.0491068*ID0HSPR + 0.0115591*JQIND333@9*TIME - 0.504755*JQIND33/EMI - 0.914095*JRWSSNF/WPI10

- 0.0189619*TIME

ID0NEWNGOOD ID0NEWNGOOD= ID0NEWNM - ID0NEWMG - ID0NEWCC

ID0NEWNM ID0NEWNM= ID0NEWCC + ID0NEWFIR + ID0NEWGV + ID0NEWSV +

ID0NEWTCU + ID0NEWWR + ID0NEWMG

ID0NEWSV = -37.4199 + 6.34223*

MOVAVG(3 TO 0,YPADJ@ID)/MOVAVG(3 TO 0,PCWC) + 0.0132715*TIME

ID0NEWWR ID0NEWWR= 0.176466 + 4.39910*

MOVAVG(3 TO 0,YPADJ@ID)/MOVAVG(3 TO 0,PCWC) + 0.0929980*TIME

ID0NEW10 ID0NEW10= 2.98222 + 5.99278*JQIND333@9 - 1.51098*

JQIND33/EMI - 5.50648*JRWSSNF/WPI10

JQIND201@7A9*TIME

ID0NEW24 ID0NEW24= 21.4669 + 8.15486*MOVAVG(1 TO 0,JQIND24)

- 13.4141*JRWSSNF/WPI08 - 0.165282*DUM821ON - 0.0337159*TIME

+0.944310*DUM841ON - 1.92169*DUM951ON + 0.00948377*TIME

- 1.65833*JQIND34/E34 + 0.0585048*

((ID0NEW20\1+ID0NEW24\1+ID0NEWMG\1+ID0NEWCC\1+ID0NEW26&27\1))

+ 0.0708939*TIME

+ 0.115231*TIME

ID0NPT ID0NPT=-0.0806903 + 1.01179*ID0NPT + 0.0718965*

 $(ID0NEW\1/ID0NEW\5)/(EEA\1/EEA\5)$

ID0WBB\$ = ID0WBBMF\$ + ID0WBBOTH\$ + ID0WBBCC\$ + ID0WBBF\$ + ID0WBBFR\$ + ID0WBBFR\$ + ID0WBBFR\$ + ID0WBBFR\$ + ID0WBBFR\$ + ID0WBBFR\$ + ID0WBBFRR + ID0WBFRR + ID0WBBFRR + ID0WBFRR + ID0WBBFRR + ID0WBBFR + ID0WBBFR + ID0WBBFR + ID0WBBFR + ID0WBBFR + ID0WBBFR + ID0WBFR + ID

ID0WBBMIL\$

ID0WBBCC\$ ID0WBBCC\$= (ID0WRWCC\$*ID0NEWCC)/1000000

ID0WBBF\$ ID0WBBF\$= -0.455862 + 0.562438*WPI02

ID0WBBMF\$ ID0WBBMF\$= (ID0WRWMF\$*ID0NEWMF)/1000000

ID0WBBMIL\$ ID0WBBMIL\$= 0.0229314 + 0.254732*(ID0NPT/N)*GFMLWSS@FAC

ID0WBBOTH\$= ID0WRWOTH\$*(ID0NEW-ID0NEWCC-ID0NEWMF)/1000000

ID0WRWCC\$ ID0WRWCC\$= 8049.05 + 1594.79*ID0AHEMF

ID0YDIR\$ ID0YDIR\$ = 0.0155789 + 1.01049*

((YINTPER+DIV+YRENTADJ)*MOVAVG(4 TO 1,ID0YP\$)/MOVAVG(4 TO 1,YP))

ID0YFC\$ ID0YFC\$= -0.130950 + 0.796230*ID0YFC\$\\ 1 + 0.136478*WPI01

ID0YINV&R\$ ID0YINV&R\$= -0.0979167 + 0.778350*ID0YINV&R\$\\1 + 0.144398*WPI01

ID0YP ID0YP=ID0YP\$/PCWC

ID0YP\$ ID0YP\$=ID0WBB\$+ID0YSUP\$+ID0YDIR\$+ID0YPRNF\$+ID0YPRF\$

+ID0YTR\$+ID0YRA\$-ID0YSI\$

ID0YPNF ID0YPNF= ID0YPNF\$/PCWC

ID0YPNF\$= ID0YP\$-ID0YPRF\$-ID0WBBF\$

ID0YPNFPC ID0YPNFPC= ID0YPNF\$/PCWC/ID0NPT

(((ID0CRCROP+ID0CRLVSTK+ID0YTRF\$+ID0YINV&R\$-ID0YFC\$-ID0FC\$

ID0EXFP)/1000))

ID0YPTXB ID0YPTXB= (ID0WBB\$+ID0YPRNF\$+ID0YDIR\$+(ID0YPRF\$-

ID0YINV&R\$/1000))/PCWC

ID0YRA\$ ID0YRA\$= -0.0788550 + 0.0286091*ID0WBB\$

ID0YSI\$= 0.0190263 + 1.02479*TWPER*ID0WBB\$/WSD

ID0YSUP\$ = -0.0873360 + 1.08920*YOL*(ID0WBB\$/WSD)

ID0YTR\$ ID0YTR\$ = 0.118262 + 0.778277*((VGF@PER+VGSL@PER)*(ID0NPT/N))

YPADJ@ID YPADJ@ID=ID0YPNF\$+MOVAVG(3 TO 0,ID0YPRF\$) + MOVAVG(3 TO

0,ID0WBBF\$)

ENDOGENOUS VARIABLES

ID0AHEMF Average hourly earnings in manufacturing

ID0AVGW\$ Average annual wage

IDOCRCROP Cash receipts, crops, not seasonally adjusted IDOCRLVSTK Cash receipts, livestock, not seasonally adjusted

ID0EXFP Farm production expenses

ID0GIA\$ Federal grants-in-aid to Idaho governments

ID0HSPR Housing starts, total

ID0HSPRS1@A Adjusted housing starts, single units ID0HSPRS2A@A Adjusted housing starts, multiple units

ID0IP26&27 Industrial production index, paper, printing, and publishing, 1992=1.0 ID0IP32&34 Industrial production index, stone, clay, glass, and concrete products and

fabricated metals, 1992=1.0

ID0IPMFDNEC Industrial production index, other durable manufacturing, 1992=1.0

ID0KHU Housing stock, total
ID0KHU1 Housing stock, single units
ID0KHU2A Housing stock, multiple units

ID0NB Number of births ID0ND Number of deaths

IDONEW Employment on nonagricultural payrolls, total

ID0NEW10 Employment in metal mining ID0NEW20 Employment in food processing

ID0NEW20@203 Employment in food processing, except canned, cured, and frozen

ID0NEW203 Employment in food processing, canned, cured, and frozen

ID0NEW24 Employment in lumber and wood products
ID0NEW26&27 Employment in paper, printing, and publishing
ID0NEW28 Employment in chemicals and allied products

ID0NEW32&34 Employment in stone, clay, glass, and concrete products and fabricated

metals

ID0NEW35 Employment in nonelectrical machinery ID0NEW36 Employment in electrical machinery

IDONEWCC Employment in construction

IDONEWFIR Employment in finance, insurance, and real estate

IDONEWGOOD Employment in goods-producing sectors

IDONEWGV Employment in government

ID0NEWGVF Employment in federal government

IDONEWGVSL Employment in state and local government

ID0NEWGVSL@ED Employment in state and local government, except education

ID0NEWGVSLED Employment in state and local government, education

IDONEWMF Employment in manufacturing

ID0NEWMFD Employment in durable manufacturing
ID0NEWMFDNEC Employment in other durable manufacturing
ID0NEWMFN Employment in nondurable manufacturing
ID0NEWMFNNEC Employment in other nondurable manufacturing

ID0NEWMG Employment in mining

ID0NEWMG@10 Employment in mining, except metal mining ID0NEWNGOOD Employment in service-producing sectors

ID0NEWNM Employment in nonmanufacturing

ID0NEWSV Employment in services

IDONEWTCU Employment in communications, transportation, and public utilities

IDONEWWR Employment in trade

ID0NMG Net in-migration of persons

IDONPT Resident population

ID0WBB\$ Wage and salary disbursements

ID0WBBCC\$ Wage and salary disbursements, construction

ID0WBBF\$ Wage and salary disbursements, farm

ID0WBBMF\$ Wage and salary disbursements, manufacturing

IDOWBBMIL\$ Wage and salary disbursements, military

ID0WBBOTH\$ Wage and salary disbursements, except farm, manufacturing, and

construction

ID0WRWCC\$ Average annual wage, construction ID0WRWMF\$ Average annual wage, manufacturing

ID0WRWOTH\$ Average annual wage, except manufacturing, construction, and farm

IDOYDIR\$ Dividend, interest, and rent income

ID0YFC\$ Corporate farm income

ID0YINV&R\$ Farm inventory value changes, imputed rent, and income

IDOYP Total personal income, 1992 dollars

ID0YP\$ Total personal income

IDOYPNF Nonfarm personal income, 1992 dollars

ID0YPNF\$ Nonfarm personal income

IDOYPNFPC Per capita nonfarm income, 1992 dollars

ID0YPRF\$ Net farm proprietors' income
ID0YPRNF\$ Nonfarm proprietors' income
ID0YPTXB Tax base, 1992 dollars

ID0YRA\$ Residence adjustment, personal income ID0YSI\$ Contributions for social insurance

ID0YSUP\$ Other labor income

ID0YTR\$ Transfer payments to persons

ID0YTRF\$ Government payments to Idaho farmers

YPADJ@ID Adjusted total personal income

EXOGENOUS VARIABLES

CNCS96C Personal consumption expenditures, clothing and shoes, 1996 dollars, chain weighted

CNFOOD96C Personal consumption expenditures, food, 1996 dollars, chain weighted Personal consumption expenditures, other nondurable goods, 1996 dollars, chain weighted

CRCATCVS Cash receipts, U.S. cattle and calves

CRCROP Cash receipts, U.S. crops

DIV Dividends

DUM801884 DUM821ON DUM841ON DUM861ON DUM861884 DUM871ON

These are dummy variables used in regression equations for the purpose of capturing the impacts of discrete economic or non-economic event such as SIC code changes, strikes, plant opening, or closures, unusual weather conditions, etc.

DUM951ON DUM981ON

TIME

E20 Employment in food processing

E24 Employment in lumber and wood products
E26 Employment in paper and paper products
E27 Employment in printing and publishing

E28 Employment in chemicals

E32 Employment in stone, clay, and glass
E34 Employment in fabricated metals
E35 Employment in nonelectrical machinery
E36 Employment in electrical machinery
EEA Total nonagricultural employment
EGF Employment in federal government
EMD Employment in durable manufacturing

EMI Employment in mining

EMN Employment in nondurable manufacturing

GFMLWSS@FAC Federal government consumption of general government employment

GF96C Federal government purchases, 1996 dollars, chain weighted

GFO96C Federal government purchases, non-defense, 1996 dollars, chain weighted

JQIND20 Industrial production index, food products, 1996=1.0

JQIND201@7A9 Industrial production index, food except beverages, 1996=1.0

JQIND24 Industrial production index, wood and lumber products, 1996=1.0

JQIND25 Industrial production index, furniture and fixtures, 1996=1.0

JQIND26 Industrial production index, paper and paper products, 1996=1.0 JQIND27 Industrial production index, printing and publishing, 1996=1.0

JQIND287 Industrial production index, agricultural chemicals, 1996=1.0

JQIND32 Industrial production index, stone, clay, and glass products, 1996=1.0

JQIND33 Industrial production index, primary metals, 1996=1.0 JQIND333@9 Industrial production index, nonferrous metals, 1996=1.0

JQIND34 Industrial production index, fabricated metal products, 1996=1.0 JQIND357 Industrial production index, office and computing equipment, 1996=1.0

JQIND367 Industrial production index, electric components, 1996=1.0

JQIND37 Industrial production index, transportation equipment, 1996=1.0

JQIND39 Industrial production index, miscellaneous manufactures, 1996=1.0

JRWSSNF Index of compensation per hour, nonfarm business sector, 1992=1.0

N Population, U.S.

N16A Population, U.S., aged 16 and older

PCWC Implicit price deflator, personal consumption, 1996=1.0, chain weighted RMMTGENS Effective conventional mortgage rate, existing homes, combined lenders

TRF\$ Government payments to U.S. farms

TWPER Personal contributions for social insurance, U.S. VAIDGF@SL Federal grants-in-aid to state and local governments

VGF@PER Federal transfer payments to persons, U.S.

VGSL@PER State and local transfer payments to persons, U.S. WPI01 Producer price index, farm products, 1982=1.0

WPI02 Producer price index, processed foods and feeds, 1982=1.0
WPI08 Producer price index, lumber and wood products, 1982=1.0
WPI10 Producer price index, metals and metal products, 1982=1.0

WSD Wage and salary disbursements

YENTNFADJ Nonfarm proprietors' income (with inventory valuation and capital

consumption adjustments)

YINTPER Personal interest income YOL Other labor income, U.S.

YP Personal income

YRENTADJ Rental income of persons with capital consumption adjustment